

ATTACHMENT 9

Mobileye Shield + Version 4.0 Collision Avoidance System with APAS (Automated Pedestrian Announcement System)

FOR

PROCUREMENT OF 40 FT LOW-FLOOR BATTERY ELECTRIC BUSES

SPECIFICATION NO. VE21-054



Massachusetts Bay Transportation Authority
Vehicle Engineering
Boston, Massachusetts

A. Background

If awarded, the Contractor shall provide, install, and fully integrate a Mobileye Shield + Version 4.0 Collision Avoidance System with APAS (Automated Pedestrian Announcement System) into each bus per the requirements of this Attachment. If awarded, this option will be incorporated into the Design Review Process during the Initial Design Review Meeting and configuration validation shall be included in Pilot bus test procedures. (TS 4.5)

1. Scope and Classification

1.1 Scope

It is the intent of this specification to describe the performance parameters for Mobileye Shield+ Version 4.0 Collision Avoidance System with APAS for Vehicle and VRU (Vulnerable Road Users), to be referenced as “System”, provided by Rosco for installation on a rigid or articulating transit bus.

2. System Parameters

- 2.1** The System shall use image processing camera-based sensors that provide an audio-visual warning to a bus operator when VRUs and vehicles become viewable to the System in daylight and low light (min 15 lux) in the event of potential imminent collision to the bus.
- 2.2** The System utilizes the VRU detection capability to trigger messages and/or visual notifications to the VRU(s) detected in the path of the moving bus.
- 2.3** The visual and audio alerts shall be configurable during installation and set-up.
- 2.4** The System provides the Mobileye/Shield+ operational and diagnostic event data messages in real-time for viewing and archiving configurable reports to a secure website.

3. Functional Parameters

- 3.1** While the bus is moving, the System shall continuously monitor:
 - 3.1.1** Objects in the external environment

- 3.1.2** Their types (persons, vehicles, cyclists, motorcycles, and other static objects such as signs for recognition of speed limits and lane markings for proper lane change., etc.).
- 3.1.3** Their distances and relative velocities within the scope of its detection when viewable to the System.
- 3.1.4** This scope shall be limited to the front and sides of the vehicle for detecting VRUs. Vehicles and VRUs are detectable during day and lowlight (min 15 lux) operations. The side sensors shall detect VRUs.
The front center sensor shall also detect and distinguish between vehicles, signs, and lane markings, as well as VRUs.
- 3.2** The System shall be able to distinguish between these external environment types, and be configurable as to how to alert / notify the bus operator in the event of a potential imminent collision with each type.
 - 3.2.1** The center display shall provide separate audio and visual alerts for each external object type.
 - 3.2.2** The side displays shall only generate an alert on pedestrians, cyclists, and motorcyclists with the same type of audio and visual alert for all these object types.
 - 3.2.3** The System shall be able to distinguish between low speed roadway environments and high speed roadway environments based on operating parameters, i.e., travel speed, and be separately configurable thresholds for each type.
 - 3.2.4** The System need not differentiate between these roadway types in its display outputs to the bus operator.
 - 3.2.5** The Shield+ Telematics can and shall differentiate between and record the roadway type for events on low speed and high speed roadways.
 - 3.2.6** The System shall distinguish between proper lane changes and accidental ones ("lane drift"). In the latter case, it shall be able to provide a lane departure warning, and shall do so if configured.
 - 3.2.7** If the bus is in motion and is determined to be on a collision course with a viewable pedestrian, cyclist or vehicle, as defined by a configurable time-to-collision threshold, the System shall provide an audio and / or visual warning (as configured) to the bus operator.

- 3.2.8** The System shall perform headway monitoring with proximate vehicles, based on current speed and the headway threshold for the current roadway type. It shall provide a warning an audio and / or visual warning (as configured) to the bus operator if the threshold is met, if so configured.
- 3.2.9** Headway monitoring engages and displays only at travel speeds at or above 20 mph.
- 3.2.10** The System shall recognize viewable Speed Limit Signs, and if so configured, provide the operator with (an) excess speed warning(s).
- 3.2.11** In the event of a potential (imminent) collision, the System shall provide a forward collision warning. The system shall determine the potential for viewable collisions based on configured parameters.
- 3.2.12** The system requires battery draw (current) after the bus engine has been shut down for up to 1 minute maximum.
- 3.2.13** The System provides an external recorded message and / or visual notification proportional to the risk of the detected VRU in the path of the moving bus.

4. Components

- 4.1** The System shall include a windshield-mounted Mobileye vision sensor unit (Vision Sensor) with a High Dynamic Range CMOS (HDRC) camera and a built-in image processing board.
- 4.2** The system shall include two exterior-mounted vision sensors one on each side of the bus near the left rear and right rear corners.
- 4.3** The rear Vision Sensors are mounted in exterior heated housings rated to IP-67. The housings and/or Vision Sensors shall be angularly adjustable and can be locked in position.
- 4.4** These rear Vision Sensors shall be configured for viewable “Vulnerable Road User” (VRU) detections and alerts. They shall not be capable of detecting or distinguishing other vehicles. (Only the front vision sensor shall be configured to recognize other vehicles forward of the bus).

- 4.5** The System shall include a Center Pedestrian/Object Display and control unit (Mobileye/Rosco dual design) that is highly visible to the bus operator. The unit shall provide visual pedestrian and vehicle warnings and shall include a numerical headway measurement display. (via Mobileye Eyewatch)
- 4.6** The System shall also include two pillar-mounted high visibility Pedestrian displays with visual and audible alerts for driver awareness of VRUs viewable in the danger zones and on collision course with the vehicle.
- 4.7** An audio alert buzzer shall be mounted inside the Pedestrian and Object Display Units.
- 4.8** The System shall include a speaker microphone system mounted for configurable audible alerts external to each side of the bus with automatic ambient noise control.
- 4.9** The System shall include a collision avoidance Electronic Control Unit (ECU) and APAS Electronic Control Unit (ECU) approved by Mobileye.
- 4.10** All parts shall be new and unused.
- 4.11** All parts shall be identical and interchangeable from bus to bus.
- 4.12** The system shall include all brackets, wiring, connectors, p-clamps, etc. needed for a complete and professional installation. All equipment shall be thoroughly secured or locked down.
- 4.13** Proposed equipment location, configuration, and test plan shall be presented to the Authority by the Contractor during the Initial Design Review Meeting.
- 4.14** System testing and validation shall be performed as part of Pilot bus testing.

5. Training

5.1 Operator Training

- 5.1.1** The Contractor shall provide Roscoe approved Operator classroom training and road training with a Shield+ equipped transitbus consistent with the requirements of TS 5.6.2.

5.2 Maintenance Training

- 5.2.1** The Contractor shall provide Roscoe approved Operator classroom training and road training with a Shield+ equipped transit bus consistent with the requirements of TS 5.6.3.

5.2.2 The Contractor shall provide Roscoe approved Master Shield+ Technician training to Bus Operations Training and Customer Technology representatives.

5.3 Transportation and OCC Training

5.3.1 The Contractor shall provide Roscoe approved training to the representatives from the MBTA Transportation and OCC departments.

5.4 Shield+ Telematics Data Training

5.4.1 The Contractor shall provide Roscoe approved Shield+ Telematics Data training including site navigation, live data evaluation, and configuring exportable reports.

5.5 Training Materials

5.5.1 The Contractor shall provide operations, diagnostic, and materials manuals and schematics consistent with the requirements of TS 5.6.1

6. Equipment and Tools

6.1 The Contractor shall provide diagnostic software and licenses, and interface cables for no less than 10% of the base quantity bus order and 10% for any Option bus order. Licenses shall be valid for no less than 2 years from the acceptance of the last bus in each order, and with all fees paid for by the Contractor.